

Docket No.: 1155-0214P
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Mamoru TAKAHASHI et al.

Application No.: 09/744,904

Confirmation No.: 8530

Filed: January 31, 2001

Art Unit: 1713

For: ETHYLENE (CO)POLYMERS AND USES
THEREOF

Examiner: R. A. Lee

DECLARATION UNDER 37 C.F.R. 1.132

MS AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

I, Naoto MATSUKAWA, declare the following:

I received my degree of M.A. in 1997 from Okayama University, Faculty of Engineering,
Department of Applied Chemistry.

I joined Mitsui Petrochemical Industries (now Mitsui Chemicals, Inc.) in 1997.

Since 1998, I have been an olefin polymerization catalysis researcher at Sodegaura
research center.

I am one of the inventors of the present invention.

I have read and understand the Office Action dated March 23, 2007 and the reference
cited therein to Malmberg et al. (Macromolecules, 1998, Vol. 31, pages 8448-8454).

Currently, claim 1 recites that the inventive ethylene (co) polymer (A1) which is either
an ethylene homopolymer or a copolymer of ethylene and an α -olefin of 4 to 20 carbon atoms,
comprises the following Features: (iv_{A1})¹ the number of branches having a length equivalent to

¹ I use herein, the numbering of the Features as used in the claims.

that of hexyl or longer measured by ^{13}C -NMR is less than 0.1 per 1,000 of carbon atoms, and (v_{A1}) the intrinsic viscosity $[\eta]$ in dl/g measured at 135°C in decalin and the melt flow rate MFR in g/10 minutes measured under 2.16 kg load at 190°C satisfy the following relations:

$$[\eta] > 1.85 \times \text{MFR}^{-0.192} \text{ when MFR} < 1, \text{ and}$$

$$[\eta] > 1.85 \times \text{MFR}^{-0.213} \text{ when MFR} \geq 1.$$

I have performed the following experiment(s) to determine that none of the polymers of Malmberg et al. have this combination of Features (iv_{A1}) and (v_{A1}).

Sample B5 is discussed at page 8450, 2nd column, lines 5-6 from bottom of Malmberg et al., and is the only example wherein the amount of branching is described. Accordingly, it is my opinion that only Sample B5 of Malmberg et al. could meet the branching Feature (iv_{A1}) of claim 1.

I now describe the process I used for repeating Sample B5 of Malmberg et al. and report that Sample B5 does not meet the MFR and intrinsic viscosity $[\eta]$ relationship described in Feature (v_{A1}) of claim 1. The experiments disclosed herein were performed by me or under my direct supervision.

Sample B5 disclosed in Malmberg et al. has been essentially repeated according to the description of Malmberg et al, which is as follows:

Experimental Section

Polymerization method: solution polymerization

Solvent: Toluene 800ml

Ethylene partial pressure: 1 bar

Catalyst: Ethylene bis indenyl zirconium dichloride (Not supported, dissolved in Toluene)

Co-catalyst: Methyl Alumoxane (MAO)

Comonomer: none

Hydrogen: not added

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Table 1 : Polymerization conditions

Sample	Catalyst: mM	Co- catalyst: mM	Ethylene Flow rate: L/hr	Polymerization Temperature:	Polymerization Time: min.	Yield: g
Run #1	0.0008	4.0	100	80	5	6.51
Run #2	0.0008	4.0	100	80	5	6.84

Table 2 : Physical Properties Of Polymer Obtained

Sample	Mn	Mw	Mw/Mn	$[\eta]$: dg/l	MFR	*1
Run #1	3.32×10^4	6.68×10^4	2.0	1.44	1.70	1.652
Run #2	3.45×10^4	6.87×10^4	2.0	1.52	1.09	1.816

*1 = $1.85 \times \text{MFR}^{0.213}$ **Condition of GPC measurement**

Equipment: Gel Permeation Chromatograph, Product of Waters Corporation
Alliance GPC 2000 series

Measurement condition:

Column: Product of Tosoh Corporation

TSKgel GMH6-HTX2 + TSKgel GMH6-HTX2

(Column size: 7.5 mm I.D. x 30 mm)

Column Temperature: 140°C

Mobile phase: o-dichlorobenzene [containing 0.025% of BHT (Butyl Hydroxy Toluene)]

Detector: differential refractometer

Flow rate: 1 mL/min.

Concentration at testing: 0.15% (W/V)

Injection volume: 500 μ L

Time interval of sampling: 1 sec.

Calibration sample: mono-dispersed polystyrene (product of Tosoh Corporation)

Condition of MFR measurement

2.16 Kg load at 190°C

Condition of $[\eta]$ measurement

Measured in decalin at 135°C

Comments/Conclusions Based on Experimental Results

As shown in Table 2, the MFR and intrinsic viscosity $[\eta]$ relationship described in Feature (v_{A1}) of claim 1 is not satisfied, i.e., Sample B5 of Malmberg et al. does not meet the requirement of $[\eta] > 1.85 \times \text{MFR}^{-0.213}$ when $\text{MFR} \geq 1$.

I am aware that the polymerization time used herein is different from that described for the sample disclosed in Malmberg et al. Specifically, the polymerization time of the experiment (5 minutes) is different from that of Malmberg et al. (60 minutes). However, for the following technical reasons, it is my opinion that the difference in polymerization time would not significantly affect the ratio of intrinsic viscosity $[\eta]$ and $\text{MFR}^{-0.213}$.

The polymer of Malmberg et al. is obtained by polymerizing olefins using a metallocene catalyst. The mechanism of the olefin polymerization is called an addition polymerization. The mechanism is described in "Chemistry of polymer synthesis," revised version (published by KAGAKUDOJIN in March 1, 1989, 11th impression of the second edition), a copy of which is attached hereto for the Examiner's convenience. The relevant part (pages 33 to 34) of which is translated to English as follows.

Among these reactions addition polymerization and polycondensation have been studied from long ago, and it is believed that addition polymerization and polycondensation proceed with chain reaction and stepwise reaction, respectively. ...

Chain reaction and stepwise reaction have essentially different polymerization mechanisms.

Generally, chain reaction comprise following 4 primary reactions:

initiation that generates unstable chain carrier,
propagation in which chain carrier react in cascade,
termination in which propagation is terminated, and chain transfer reaction.

Supposing that M stands for monomer, P stands for polymer, and A stands for substance that can cause chain transfer reaction; each reaction can be described as follows:

Initiation:	$M \rightarrow M^*$
Propagation:	$M_n \rightarrow M_n^*$
Termination:	$M_n \rightarrow P$
Chain transfer:	$M_n^* + A \rightarrow P + A^*$

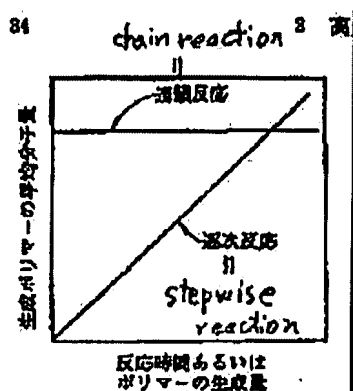
wherein M_n^* is the chain carrier and any of radical, anion or cation. Among these primary reactions, Initiation is the slowest one, and once a chain carrier is generated, propagation occurs immediately.

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Generally, when polymerization proceeds with chain reaction, average molecular weight of the resultant polymer is constant as in figure 2-1, regardless of time of reaction. To the contrary, in stepwise reaction functional group react consecutively to form polymer. There are no unstable intermediates such as chain carrier in the reaction, and average molecular weight of the polymer increase with time of reaction as in figure 2-1.

Figure 2-1



[caption]

Relation between average molecular weight of the polymer and time of reaction for chain reaction and stepwise reaction

[Y-axis]

average molecular weight of polymer

[X-axis]

time of polymerization reaction

This teaching can be summarized follows.

With respect to polymerization, there are chain reactions and stepwise reactions. In the case of addition polymerization, the reaction proceeds with chain reaction. The average molecular weight is constant regardless of polymerization time.

So the polymer properties such as MFR and intrinsic viscosity, which are closely related to the molecular weight of a polymer, are not expected to change with time. As such, it is my opinion that the difference in polymerization time between Sample B5 of Malmberg et al. and the polymerization time reported herein would not significantly affect the ratio of intrinsic viscosity $[\eta]$ and MFR^{0.213}.

In a *separate matter*, the Examiner expressed during the recent Interview with my representative, Dr. Dahlen, that the ratio of catalyst to cocatalyst is an important variable. The Examiner is aware that Malmberg et al. do not disclose the ratio of catalyst/cocatalyst. The Examiner is concerned that the catalyst/cocatalyst ratio affects the MFR and intrinsic viscosity $[\eta]$ of the Sample B5. I respectfully disagree with the Examiner.

First, if the ratio of catalyst/co-catalyst greatly affects the properties of the polymer produced, then it makes sense that Malmberg et al. have not placed into possession of the public the polymer of Sample B5. In other words, based on this logic, if the ratio is not disclosed, then Sample B5 of Malmberg et al. could not be reproduced.

Second, I conducted the experiments to show that Sample B5 does not satisfy the equation regarding MFR and $[\eta]$ of the present claim, believing that the effect of the co-catalyst/catalyst ratio is small. It is my opinion that the experiments described herein are sufficient to show that the Sample B5 does not satisfy the relation of the claim regarding MFR and $[\eta]$.

It is my opinion that since the polymerization conditions are not disclosed in Malmberg et al., it is logical to assume that the polymerization conditions are in the normal range that one skilled in the art would select. As such, there is not a big difference between the polymerization conditions of the experiments described herein and that of Malmberg et al.

In conclusion, it is my opinion that none of the polymers of Malmberg et al. have the inventive combination of Features (iv_{A1}) and (v_{A1}).

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Dated: August 21, 2007By Naoto Matsukawa
Naoto Matsukawa

Attached: "Chemistry of polymer synthesis," revised version (published by KAGAKUDOJIN in March 1, 1989, 11th impression of the second edition).



改訂高分子合成の化学

大津 隆行 著

化学同人

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